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ठोस अवस्था में प्लान्टेशन व्हाइट शुगर की  
सफेदी मापने की फोटोइलेक्ट्रिक  
परावर्तक पद्धति  
( दूसरा पुनरीक्षण )

**Photoelectric Reflectance  
Method for Measurement of  
Whiteness of Plantation White  
Sugar in Solid State**  
( Second Revision )

ICS 67.180.10

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## FOREWORD

This Indian Standard (Second Revision) was adopted by Bureau of Indian Standards after the draft finalized by Sugar Industry Sectional Committee had been approved by the Agricultural and Food Products Division Council.

Plantation white sugar is manufactured and commercially transacted on the basis of visual comparison of colour and grain size as prescribed in IS 498. While grain size determined by employing various sieves, whiteness of sugar in reference samples prepared by Bureau of Sugar Standards is determined by Photoelectric Reflectance Meter.

The principal object of the development of this standard covering photoelectric reflectance method is to specify procedure for preparing reference samples of identical whiteness eliminating personal errors. This is necessary to be done every year as whiteness is affected during storage. Besides, the standard method would also help in scientific evaluation of such issues as the introduction of new colour grades.

This Standard was first published in 1974 to cover plantation white sugar manufactured and commercially transacted on the basis of visual comparison of colour and grain size as was prescribed in IS 498. IS 498 was revised in 2003 in the light of decision of Government of India to reduce the number of sugar grades to six only in two colour series namely:

- a) L-30, M-30, S-30 ; and
- b) L-29, M-29 and S-29.

These six grades were included in revised IS 498. Due to various changes in the technology of sugar manufacture and hence the sugar quality also, the standard IS 498 was further revised in and a new 31 colour series has been introduced, while 29 colour series is abolished. After introduction of a new grade SS-31 total seven numbers of grades in force. In light of the above changes and also considering change in the quality of plantation white sugar being produced, it became imperative to revise IS 7424 giving the modulated reflectance values of these seven grades.

Reflectance values of sugar are obtained through photoelectric reflectance meter, which are converted to Modulated Reflectance (MR) values, by multiplying them with average grain size of sugar. The MR values thus obtained are utilized for gradation of plantation white sugar.

This standard is based on extensive research investigations carried out on the method of evaluation of whiteness of plantation sugar in solid state at National Sugar Institute, Kanpur. The method was published and elaborated in proceedings of 4<sup>th</sup> joint convention of Sugar Technologists Association. The method was also rechecked at National Physical Laboratory, New Delhi earlier.

With a view to facilitate preparation of reference samples of sugar or to arrive independently at the modulated reflectance values of different grades of plantation white sugar, the MR values are given in **Annex A**.

The composition of the committee responsible for the formulation of this standard is given in Annex B.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

## *Indian Standard*

# PHOTOELECTRIC REFLECTANCE METHOD FOR MEASUREMENT OF WHITENESS OF PLANTATION WHITE SUGAR IN SOLID STATE

( *Second Revision* )

## 1 SCOPE

**1.1** This standard prescribes the method of measurement of whiteness of plantation white sugar (vacuum pan) in solid state by means of photoelectric reflectance meter for preparation of reference samples and introduction of higher colour grades.

**1.2** This method is not intended for day-to-day routine grading of sugar in sugar factories which shall be done on the basis of visual comparison with reference samples.

## 2 APPARATUS

### 2.1 Photo-Electric Reflectance Meter

It shall preferably be furnished with two-way operation from both 230 V ac mains and 9 V storage batteries. It shall be provided with a search unit and a digital display unit with accuracy up to two digits after decimal.

**2.1.1** For mains operation, a constant voltage transformer or an equivalent device shall be provided to keep constant voltage supply to the system. The complete unit consists search unit with connector cord, calibration plaque plates, black cavity and colour filters.

**2.1.2** The search unit shall be provided with a 9 V concentrated filament lamp. Suitable colour correcting filter or filters shall be placed in the parallel beam of light. The filters shall be used to correct the colour sensitivity of the photo-cell to match it with that of the eye. The operating voltage of the lamp shall be specified.

**2.1.3** The function buttons control basic operations. When power button turn on, red light in display will lit up. The appropriate colour filter shall be used in search unit to get the proper results from plaque plates (used for calibration) and black cavity. Calibration buttons are used to set blank (zero) and standard readings (mentioned on plaque plates for each of three colours).

### 2.2 Reflectance Standard

It shall be a freshly prepared magnesium oxide surface whose reflectance shall be taken to be 100 percent.

However, for convenience, the following reflectance standards shall be provided with the instrument:

- a) A white enamel plaque of reflectance not less than 80 percent with its reflectance value calibrated against magnesium oxide.
- b) A grey enamel plaque of reflectance about 40 percent with its reflectance calibrated against magnesium oxide.
- c) A highly polished black glass plate.

## 3 MEASUREMENT OF REFLECTANCE

**3.1** When measuring samples **amber, blue and green** buttons shall be used to select appropriate calibration curve for specific tri-stimulus filter in search unit. When one of these three buttons is depressed, the corresponding LED above it will illuminate and indicates which filter calibration curve is being used. When filters are changed in search unit, the corresponding channel shall be selected via **amber, blue, and green** buttons. Filters and their corresponding memory settings shall be changed at will, once the system has been calibrated. Only those channels that are being used for samples shall be calibrated.

**3.2** To calibrate the system desired filter channel shall be selected via **amber, blue and green** buttons. Next the **CHANGE** button is to be depressed causing **CHANGE** led to illuminate. The instrument /system shall now be ready for a two point calibration starting with zero offset and followed by Standard plaque plate value setting.

**3.2.1** The first step of calibration is to set **BLACK CAVITY** zero offset (dark current correction). The black cavity standard shall be placed on search unit before this measurement is taken. Once the black cavity is in place on search unit and **CALIBRATE** mode has been entered. **ZERO** button shall be depressed. This will cause the **CHANGE** light to go out and normal reflectance display to resume. While the black cavity standard is on search unit, system should display between 0.10 and (-) 0.10. If it does not produce this value the calibration should be repeated.

**3.2.2** After the zero offset has been set, the second calibration point shall be determined by using standard plaque value, follow the procedure given below:

- a) Place the standard plaque plate with the recessed glazed surface towards the search unit.
- b) Press CALIBRATE button. The calibrate light will illuminate, and then press STD button. The STD light will illuminate as well as all three filter lights (amber, blue and green) also.
- c) The display will show any reflectance value or previously entered standard plaque value.
- d) Read assigned plaque reflectance value for selected colour from label on standard plaque plate.
- e) Enter the standard value in the system using **amber, blue and green** buttons to increment the tens, units, and tenths digits respectively. The digits will individually increment between 0 to 9 units, when buttons are depressed. Standard plaque plate values between 00.0 to 99.9 can be entered in to the system.
- f) When desired /required reading is set /appears on the display, depress STD button, second time /Twice. The STD Led will extinguish, as well as CALIBRATE Led also. Normal reflectance display will resume and display should be identical as standard plaque value ( + 0.2) after the standard plaque value is entered.

System is now ready to measure the reflectance value of any sugar sample (in the standard glass bottle) put

it on the search unit by replacing the standard plate for the newly calibrated /set colour filter.

**3.3** Connect instrument to a.c. power mains or to 9 V storage batteries. Put the green filter (colour correcting filter) in the search unit and place the polished black cavity it on. The display shall then indicate zero reflectance, if not, adjust zero controls to set display to zero; then place standard white plaque on search unit and adjust the sensitivity controls to get correct reflectance reading for this calibrated plaque (if not set previously). Now place grey enamel plaque on search unit and check that display gives correct value of reflectance for calibrated plaque. The plaques and black plates shall be washed with neutral detergents or soft soaps and dried before use. Care shall be taken not to scratch their surfaces, specifically that of black cavity. After suitable intervals reflectance values of white and grey enamel plaques shall be checked against magnesium oxide standard. Now the instrument is ready for measurement.

#### 4 CALCULATION

Take the mean reflectance value of the four surfaces of the sugar in the bottle. Obtain the modulated reflectance (MR) values by the following formula:

$$\text{Modulated Reflectance (MR)} = R \times G$$

R = Mean reflectance value of the four surfaces of the sugar, in bottle; and

G = Average grain size of the sugar, in mm.

**ANNEX A***( Foreword )***MINIMUM VALUES OF MODULATED REFLECTANCE  
OF PLANTATION WHITE SUGAR\***

<b>Standard Mr Values</b>			
<b>Grain Size Designation</b>	<b>Grain Size, (In mm)</b>		<b>Standard MR Values Minimum*</b>
	<i>Max.</i>	<i>Min.</i>	
L-31	2.36	1.70	91
M-31	1.70	1.18	70
S-31	1.18	0.60	49
SS-31	0.60	0.212	27
L-30	2.36	1.70	85
M-30	1.73	1.18	62
S-30	1.18	0.60	43

\* As recorded in the first week of September every year.

**ANNEX B***( Foreword )***COMMITTEE COMPOSITION**

Sugar Industry Sectional Committee, FAD 02

<i>Organization</i>	<i>Representative(s)</i>
National Sugar Insititure, Kanpur	SHRI NARENDRA MOHAN ( <b><i>Chairman</i></b> ) SHRI ASHUTOSH BAJPAI ( <i>Alternate</i> )
Army Service Core (ASC), New Delhi	LT COL B. B. SAHU
CONCERT, Chennai	SHRI R. SANTHANAM SHRI M. SOMASUNDARAM ( <i>Alternate</i> )
Consumer Guidance Society of India, Mumbai	SHRI SITARAM DIXIT DR M. S. KAMAT ( <i>Alternate</i> )
Food Corporation of India, New Delhi	SHRI DEEPAK KUMAR PANWAR SHRI RAKESH KUMAR RANJAN ( <i>Alternate</i> )
Food Safety Standards Authority of India, New Delhi	MS APOORVA SRIVASTAVA (TECHNICAL OFFICER)
Global Cane Sugar Ltd, New Delhi	DR G. S. C. RAO MR ANIL SRIVASTAVA ( <i>Alternate</i> )
Indian Institute of Sugarcane Research, Lucknow	DR A. D. PATHAK DR A. K. SHARMA ( <i>Alternate</i> )
Indian Institute of Toxicology Research, Lucknow	DR YOGESHWER SHUKLA
Indian Sugar Mills Association, New Delhi	SHRI G. K. THAKUR SHRI PANKAJ RASTOGI ( <i>Alternate</i> )
Indian Sugar Exim Corporation, New Delhi	MR RAJIV AGGARWAL MR RAJEEV KURUP ( <i>Alternate</i> )
Ministry of Consumer Affairs, Food & Public Distribution, New Delhi	SHRI SURESH CHANDRA
National Co-operative Development Corporation, New Delhi	SHRI K. P. VAISH SHRI N. K. SHARDA ( <i>Alternate</i> )
National Fed. Of Co-operative Development Corporation, New Delhi	MR MANOHAR GOPAL JOSHI
The Sugar Technologists Association of India, New Delhi	SHRI SANJAY AWASTHI SHRI ANURAG GOYAL ( <i>Alternate</i> )
Triveni Engineering & Industries Ltd, Muzaffarnagar, UP	MR RAJESH SINGH SHRI P. K. KHADELWAL ( <i>Alternate</i> )
BIS Directorate General	SHRI P. RAJESH, SCIENTIST 'E' AND HEAD (FAD) [REPRESENTING DIRECTOR GENERAL ( <i>Ex-officio</i> )]

*Member Secretary*SHRI RAJPAL  
SCIENTIST 'C', BIS



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